



## SoundWare XS Digital Cinema Technical White Paper

The SoundWare XS Digital Cinema brings together two critically acclaimed Boston product families, TVee and SoundWare. Boston's TVee soundbar products enhance our customers' TV/movie/game/music listening experience, while making set-up and use as simple as possible. Boston's SoundWare speakers place high performance electroacoustic components in a compact and versatile multi-faceted shape. Boston combines these virtues – sound, shape, and simplicity – in the SoundWare XS Digital Cinema.

SoundWare XS Digital Cinema includes two SoundWare XS satellite speakers, designed to be placed near the television, on a shelf or table, or on the wall (pivoting brackets are included). The tiny subwoofer box is both the connection center for inputs and contains digital signal processing circuitry and amplifiers for the system – typically the subwoofer will be placed near the furniture holding the television. A small Control Pod contains indicator lights and the infrared remote sensor – this Control Pod is to be placed in a prominent position near the TV, and acts as the status indicator and control point for the system.

Every television on the market is a tremendously capable control center – with multiple audio/video inputs, and in many cases sources like Netflix and Pandora radio built in. These televisions – plus a Blu-ray and cable/satellite box – are just about everything a person could want for a living room entertainment system. Due to cost squeezing (to be price competitive) and size squeezing (to make them super thin), televisions typically have crummy sound. Boston's new SoundWare XS Digital Cinema hooks up to the audio output (most often, by one digital optical cable, supplied) and plays exactly what the television is showing – except with dramatically better sound.



SoundWare XS Digital Cinema learns the television's remote control commands, so the owner doesn't have to add yet another remote to the coffee table. Since the same television (or cable box/TiVo/satellite box) remote now works Digital Cinema, operating the system becomes transparent and second nature – no change from just operating the television. And, a small credit card-sized remote is included for setting up the system and programming in the user's remote. Even after the system is programmed to work from the owner's own remote, the supplied remote will still work as a backup.

## Optical Digital Input and Dolby Digital Decoding

Most of televisions (larger than 26") on the market now routinely include an optical digital output, a small square jack on the rear panel that conveys a digital signal by red light, through an optical digital cable. This optical digital connection is also sometimes called "Toslink" – it's the same thing. This is a version of the Sony/Philips Digital Interconnect Format (S/PDIF), an industry standard. The television's optical output sends out whatever program is coming into the television, or playing on its internal digital TV tuner, in the form of either a Dolby Digital signal or a plain digital signal, sometimes called a PCM (pulse code modulation) signal. Since the signal can be either Dolby or PCM, it is very important for the Digital Cinema to be able to play both types of audio signal.

In sending out audio to the Digital Cinema, the television also performs another useful function – it handles all the different audio types coming from sources such as Blu-ray. Many Blu-ray discs include soundtracks

encoded with DTS multichannel sound – a theater sound format that competes with Dolby. Hooked up to the Blu-ray with an HDMI audio/video cable, the television “negotiates” with the source and tells it to send program the television itself can decode – PCM audio – and this is conveyed on to the Digital Cinema via the optical connection. This is why the Boston system decodes both Dolby Digital and PCM audio.

Even though it is a “2.1” system, with two satellites and one subwoofer, the SoundWare XS Digital Cinema includes a true 5.1 channel Dolby Digital decoder (5.1 refers to 5 main channels plus a “.1” Low Frequency Effects channel). This is unusual – most soundbars and integrated home theater products on the market, and pretty much all televisions, make do with a less expensive 2 channel decoder, where 5.1 channels from a source are heard, but they are mixed down to the 2 speaker channels. Boston’s use of a true 5.1 channel decoder permits a more sophisticated handling of all the sound channels, called Digitally Optimized Virtual Surround, described below.

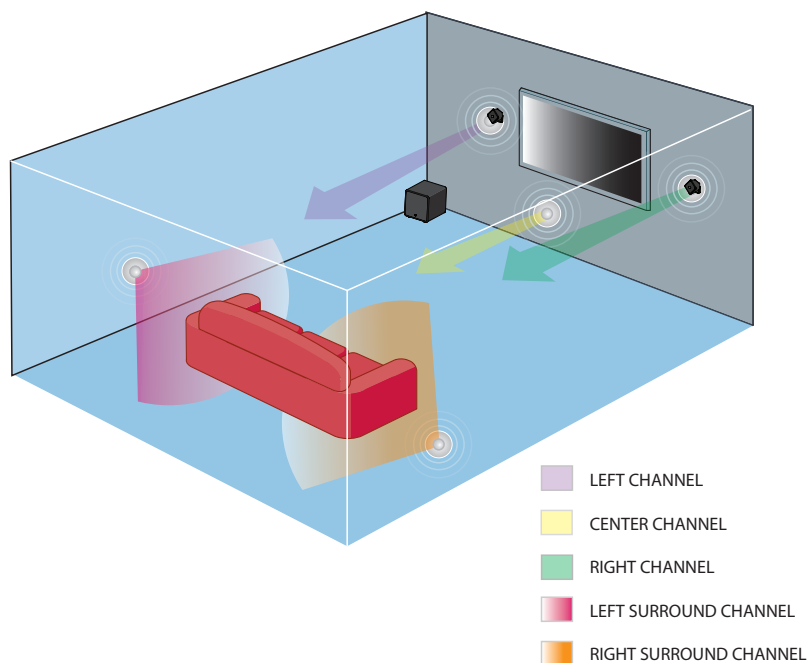
For the owner whose current television lacks an optical digital output, the Digital Cinema has an analog input connection (left and right “RCA” or “phono plug” connections) – and these televisions have either the same type RCA outputs, or a 3.5mm (1/8”) mini-plug headphone output. Both of these work fine sending the television’s audio to the soundbar. In this case, the Digital Cinema converts the sound to a digital signal, decodes surround signal, and applies the same Digitally Optimized Virtual Surround.

All audio coming into the Digital Cinema is maintained in digital form, through the processing described below, to the digital amplifiers.

## Digitally Optimized Virtual Surround

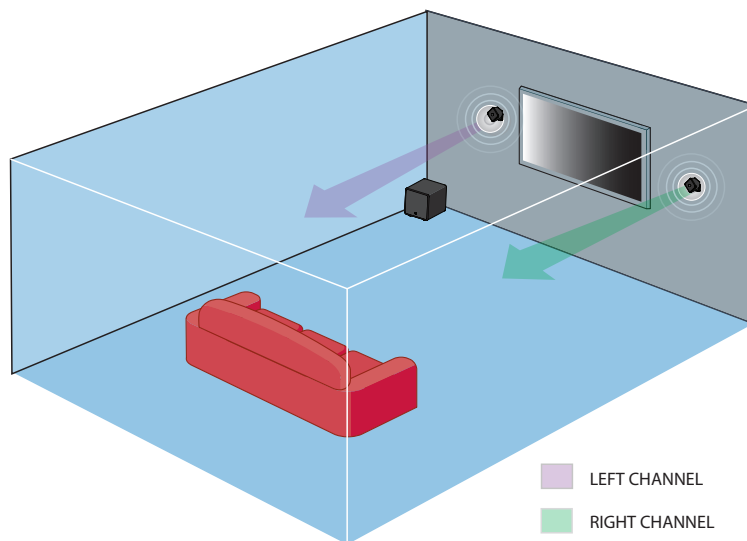


Boston’s Digitally Optimized Virtual Surround (DOVS) recreates the cinema surround experience using a more sophisticated method than is found in competing products. Most soundbars and 2.1 channel home theater products on the market take 2 decoded channels of sound, and apply processing to spread the sound to the left and right in the room, resulting in individual sounds locations seeming smeared.



The DOVS Movie Mode first starts with all 5 main decoded channels – Left, Center, Right, Surround Left, and Surround Right. In the case of a 2.0 (2 channel) surround sound source – which is many movies and television programs that weren’t mixed in 5.1 – we digitally derive all the channels. Then DOVS places the sounds in the correct locations – Left, Center, Right, as well as virtual Surround. And, we create a virtual center channel as well. This is quite different from our some competing products’ “big wide sound” indiscriminately applied to all the channels.

DOVS Movie Mode plays 5 virtual channels like a cinema



DOVS provides an additional valuable feature – a Music playback mode. Music Mode also makes use of our ability to locate sounds, but we place the sound in front of the listener, much the way a high-end two-channel pure-audio system would. As with the Movie Mode, Music Mode can be applied to any type of digital or analog input, as well as wirelessly streamed Bluetooth sources. And, the SoundWare XS Digital Cinema will remember what Mode you last chose for each input.

DOVS Music Mode plays 2 channels like a pure audio music system

## DSP Equalization and BassTrac®

Boston's Digital Cinema uses Digital Signal Processing (DSP) to apply sonic equalization, cross the sound over from the satellites to subwoofer, and add Boston's BassTrac bass boost to the subwoofer.

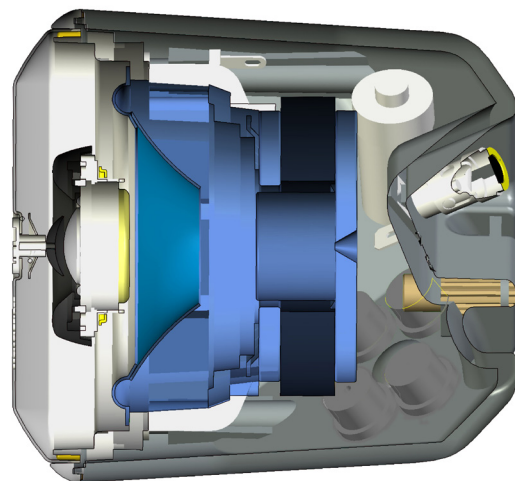
In designing the Digital Cinema, Boston Acoustics brings its 30+ years of acoustic design expertise to a focus, and uses the powerful built-in DSP equalization to guarantee a flat, uncolored response. While Boston makes many traditional speakers that don't use DSP active equalization at all (since they work with any brand of AV receiver or amplifier), the Digital Cinema's DSP equalization allows a much more efficient use of amplifier power and more flexibility with the physical design of the speaker enclosures. In other words, the small size of Digital Cinema is made possible in part by this equalization technology.

Similarly, we achieve remarkable results from the subwoofer, and a smooth acoustic transition to the satellites, by careful use of equalization. The subwoofer employs bass management to convey the bass sound from all the channels – whether 2 or 5, as well as the ".1" – the powerful "low frequency effects" (LFE) track found in movie mixes. Boston's BassTrac technology guarantees the bass stays powerful and satisfying, keeping the sound clean and clear.

## Amplification and Speakers

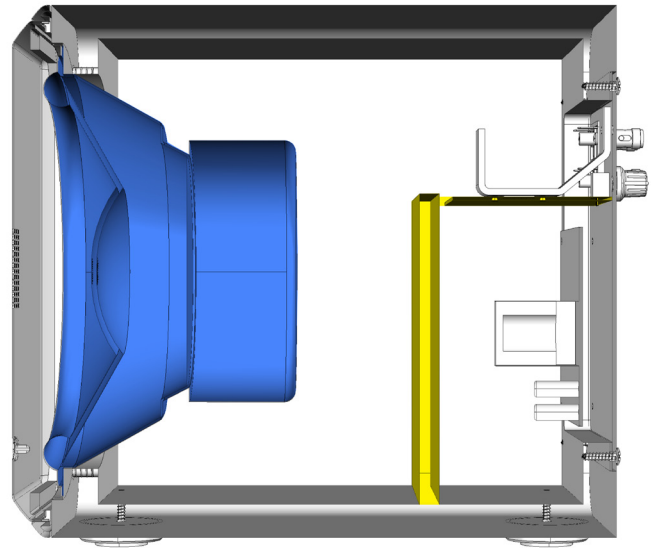
The SoundWare XS Digital Cinema uses Class D "Pulse Width Modulation" digital amplification – a clean and efficient technology that helps us pack this level of performance in a size that would be impossible with less efficient designs. Each subwoofer includes a level trim control for adjusting the bass level for a particular room – this is a set-and-forget adjustment.

Each XS satellite includes 2½" (64mm) mid-bass woofers with organic pulp cones – this material is both rigid and acoustically dead, reducing distortion. These woofers also include copper-clad aluminum windings on a synthetic voice coil former – materials which increase power handling and reliability of the system.



Each satellite's centrally mounted tweeter is a ½" (12mm) Mylar dome. The central location not only helps acoustically integrate the drivers, it also allows a much smaller cabinet compared with conventional tweeter-over-woofer layouts.

The Digital Cinema's subwoofer employs a potent 8" subwoofer driver with an organic pulp cone, rubber surround, and copper windings on a synthetic voice coil former, and feature Boston's Deep Channel® Design (DCD). Developed over the last 15 years for Boston's home and car speakers, DCD technology permits greater movement of the woofer cone while at the same time maintaining the full magnetic force necessary for an efficient and dynamic acoustic output, optimizing use of the amplifier's power.



Boston's engineers tune the speakers both with computer simulations and with proprietary multi-channel measurement systems. These systems allow simultaneous analysis of frequency response, total harmonic distortion, and impedance. After optimizing the speaker elements and crossover for both on-and off-axis frequency smoothness, the engineers and expert listeners at Boston Acoustics confirm the sound with a variety of music and movie program material. The result is a smooth and natural sound.

### **SoundWare XS Digital Cinema's distinctive shape and design**

The SoundWare satellites cabinets are made from a blend of ABS and polycarbonate plastic, making possible the glossy and durable finish. SoundWare's signature multifaceted shape simplifies placement and the included multi-direction bracket permits easy placement and aiming of the satellite. The XS satellite's speaker grilles are powder-coat-painted perforated aluminum, which passes the sound cleanly through to the listener.

The subwoofer's unusually small shape is made possible by active equalization, provided by the digital signal processing mentioned above. A sealed enclosure – excellent for low distortion – is combined with fourth-order high pass filter equalization for true home theater extension.

### **Bluetooth A2DP wireless music streaming**



The SoundWare XS Digital Cinema includes a built-in Bluetooth A2DP receiver, enabling the use to turn almost any smartphone, iPhone, iPad, iPod touch, Droid, HTC, etc. as well as most laptops, into a first-rate wireless music streaming device. Using the Bluetooth Advanced Audio Distribution Profile (A2DP) built into these phones, the owner may pair with the Digital Cinema and stream any audio content on the phone, as well as other audio sources on the phone such as Pandora, Rhapsody, etc.

A2DP is a much higher quality transmission system compared with the "headset" profile people use for talking on the phone. Note that older phones (>3 years old, such as the iPhone 3G) broadcast in a slightly lower quality than newer products (iPhone 3GS, iPhone 4/4S, latest iPod touch, any iPad, any current Droid, etc.) which send the highest quality Bluetooth A2DP.

SoundWare XS Digital Cinema has several auto-pairing features – such as when first set up, the Bluetooth input is automatically ready to pair with a phone. And, if you take your phone with you out of the house, when you come back, the system is paired again, ready to go.

Features a glance...	SoundWare XS Digital Cinema
Optical digital input	✓
Dolby Digital 5.1 decoding	✓
PCM audio compatible with sample rates 32-192 kHz, 16-24 bits	✓
Aux inputs (RCA jacks and 3.5mm mini-plug)	✓
300MHz Fixed Point Digital Signal Processor (DSP)	✓
Bluetooth music streaming input (A2DP using SBC codec)	✓
Digitally Optimized Virtual Surround	✓
Switchable Music and Movie modes	✓
Amplifier power	250 watts total system power
Speakers	2.1 channel system:
Satellite	2½" mid-bass drivers
	½" tweeters
Subwoofer	8" DCD subwoofer driver
in a sealed enclosure chamber	✓
Remote control infra-red (IR) learning, using industry standard	✓
Wall bracket included	✓
Remote Included	✓

## SoundWare XS Digital Cinema FAQ

### Do I hook all my sources to Digital Cinema directly?

>>No. Since your television (if it was made in the last 4-5 years) has lots of inputs, use it as your switching system – and if possible hook all your sources by HDMI cable to the television. That way, when you select a source on your television, the sound will automatically go out to the Digital Cinema. However, the system also has some convenient audio-only inputs – these are handy for a source such as an iPod.

### After I hook up the SoundWare XS Digital Cinema, what happens to the sound coming out of the television's speakers?

>>All you have to do is shut off the television's internal speakers. Typically, this is an "Audio Setting" choice in your television's set-up menu.

### My television doesn't have a digital optical output (this is rare), so how do I hook up my system?

>>Tvee has an auxiliary analog input. All you have to do is use the included RCA cable to hook the television's analog outputs to the system's aux input. If the only output on the television is a headphone jack, that will work fine too. All you need is a headphone plug to RCA plug adaptor, available at your audio retailer.

### Can I play a CD on Digital Cinema?

>>Yes. You can play a CD on your DVD or Blu-ray player. If that player is hooked to a selected input on your television, SoundWare XS Digital Cinema will play the sound.

### How does a Blu-ray disc with a DTS soundtrack play on SoundWare XS Digital Cinema, when the system decodes Dolby but not DTS?

>>When you hook your Blu-ray to your television using an HDMI cable, the television "tells" the Blu-ray to use its internal DTS decoder and send pure digital signals down the line. These same digital signals go through the optical cable and play fine on Digital Cinema.

**Where should I place my subwoofer?**

>>Place the sub near the furniture or cabinet holding the television, so the cables from television and satellites can reach it. The provided speaker and control pod wires are 15 ft (4m) long. The provided optical digital and RCA wires are 10 ft (3m long). Placement near a corner will give the loudest sound. You will need to plug the subwoofer's AC plug into a nearby outlet.

**How do I adjust how loud the subwoofer plays?**

>>The subwoofer has a volume trim control on it. Typically, setting the knob around 12 o'clock will sound right. Once you set the knob, typically you won't need to adjust it.

**Does the subwoofer play the "LFE" track from a movie?**

>>Yes, the subwoofer plays bass from all channels – whether 2 channel sources or 5.1 – including the "Low Frequency Effects" of a movie soundtrack. Sometimes the bass in a movie will seem louder than bass in music – just like a movie theater.

**Do I have to use Movie Mode on movies and Music Mode on music?**

>>No, either mode can be used for any kind of source including Bluetooth. The Movie Mode gives a bigger sound like a theater, and the Music Mode sounds more like two speakers playing in front of you, like a musical performance. TVee will also remember what Mode you last chose for each input.